

## Astronomy

**ES-2 The student will demonstrate an understanding of the structure and properties of the universe.**

### **ES-2.6 Compare the information obtained through the use of x-ray, radio, and visual (reflecting and refracting) telescopes.**

**Taxonomy level:** 2.6-B Understand Conceptual Knowledge

**Previous/future knowledge:** Students in 4<sup>th</sup> grade were introduced to the telescope as a tool of astronomers. In 8<sup>th</sup> grade students compared the purpose of tools and technology that scientists use, including the telescope, but not the structure of telescopes. In Earth Science students will now compare specific telescopes in order to determine the information that can be gathered from each type.

**It is essential for students to know** that x-ray, radio, and visual telescopes are each constructed in such a way as to allow information to be gathered regarding objects and events in the universe. Objects in space emit radiation in all frequencies of the electromagnetic spectrum. Some of the wavelengths the human eye cannot detect so a variety of telescopes have been developed. The goal of all telescopes is to bring as much radiation as possible to a focus.

#### ***X-ray Telescopes***

- Since x-rays cannot be easily reflected by any surface, a special design for detecting x-rays had to be developed.
- An arrangement of cylindrical mirrors allows X-rays to be guided to a precise focus to form an image.

#### ***Visual Telescopes***

##### ***Reflecting***

- Uses a concave mirror instead of an objective lens to focus a large amount of light onto a small area; the larger the mirror, the more light the telescope can collect;
- A flat mirror reflects the light to the eyepiece lens.
- The majority of visual telescopes used today are reflecting.

##### ***Refracting***

- Uses convex lenses to bring visible light to a focus;
- The largest lens is called the objective lens; the second lens is the eyepiece lens;
- When light passes through the objective lens, the lens focuses the light at a certain distance away from the lens; the larger the objective lens, the more light it can collect.

#### ***Radio Telescopes***

- Most radio telescopes have curved, reflecting surfaces that are used to detect radio waves from object in space;
- The surface of the telescope concentrates faint radio waves onto small antennas.

**It is not essential for students to** use ray diagrams to trace the path of incoming radiation into the various telescopes. It is not necessary for a complete study of the Hubble Space telescope to be part of this indicator, but it may make an interesting additional study.

#### **Assessment Guidelines:**

The objective of this indicator is to *compare* information gathered from types of telescopes; therefore, the primary focus of assessment should be to detect ways that these instruments are alike or different in regards to the collection of information from space.

In addition to *compare* appropriate assessments may require students to:

- *interpret* diagrams that show how a telescope collects information;
- *compare* the visual reflecting and refracting telescopes; or
- *identify* a telescope based on a description of the information it is able to collect.